

WHAT IS CLAIMED IS:

1. A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station having higher precision of frequency and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator,

wherein coordinate rotation digital computation (CORDIC) is employed for calculation of arctangent in said automatic frequency control.

2. A portable radio system as set forth in claim 1, wherein, upon calculation of arctangent, calculation is performed within a range of $\pm \pi$.

3. A portable radio system as set forth in claim 1, wherein, upon performing calculation of said frequency shift, parameters CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal to be calculated the phase with I and Q components, and in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

$\text{CORDICi} = \text{CORDICq}$

$\text{CORDICq} = \text{CORDICi} * -1.0$

5 $\text{phase} = \pi / 2$

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

$\text{CORDICi} = \text{CORDICq} * -1.0$

$\text{CORDICq} = \text{CORDICi}$

10 $\text{phase} = -(\pi / 2)$

is performed.

4. A portable radio system as set forth in claim 1, wherein,
15 upon performing calculation of said frequency shift, parameters
CORDICi and CORDICq are derived by using a calculation of said
coordinate rotation digital computation by replacing the signal
to be calculated the phase with I and Q components, and in
calculation of said coordinate rotation digital computation,
20 when a parameter for outputting a final angle by adding angles
per taps is set as phase, in former stage of said coordinate
rotation digital computation, a process expressed by:

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

5 when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = $-\pi$

10 is performed.

5. A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave 15 transmitted from a base station having higher precision of frequency and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises; calculating means for calculating a phase difference of 20 two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator; frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval

of said two symbols; and

control means for controlling for widening said interval when said phase difference derived by said calculating means is smaller than a predetermined set value and for narrowing 5 said interval when said phase difference is greater than said set value.

6. A portable radio system as set forth in claim 5, wherein said two symbols are the same phase when a frequency of said 10 internal oscillator is correct, and

said calculating means derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol.

15 7. A portable radio system as set forth in claim 5, wherein upon calculation of arctangent by employing coordinate rotation digital computation (CORDIC), said frequency shift calculating means performs calculation within a range of $\pm \pi$

20 8. A portable radio system as set forth in claim 7, wherein, upon performing calculation of said frequency shift, parameters CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal to be calculated the phase with I and Q components, and in 25 calculation of said coordinate rotation digital computation,

when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

5 when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase = $\pi/2$

10 when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase = $-(\pi/2)$

15 is performed.

9. A portable radio system as set forth in claim 7, wherein, upon performing calculation of said frequency shift, parameters CORDICi and CORDICq are derived by using a calculation of said 20 coordinate rotation digital computation by replacing the signal to be calculated the phase with I and Q components, and in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate

rotation digital computation, a process expressed by:

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

5 CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

10 CORDICq = CORDICq * -1

phase = $-\pi$

is performed.

15 10. A portable radio system as set forth in claim 5, wherein said control means sets said interval at a predetermined minimum value when out of synchronization is detected at least from failure of decoding or non-detection of pilot and not reaching of power to a predetermined level.

20

N. A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of a portable radio equipment with reference to a received wave transmitted from a base station having higher precision of

frequency and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, wherein said portable radio equipment comprises:

5 calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval 10 of said two symbols; and

control means for controlling for widening said interval when a value of said frequency shift derived by said frequency shift calculating means is smaller than a predetermined value and for narrowing said interval when said value of said frequency 15 shift is greater than said predetermined value.

Sub A 12. A portable radio system as set forth in claim 12, wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

20 said calculating means derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol.

13. A portable radio system as set forth in claim 12, wherein 25 upon calculation of arctangent of coordinate rotation digital

computation (CORDIC), said frequency shift calculating means performs calculation within a range of $\pm \pi$.

14. A portable radio system as set forth in claim 13, wherein,
5 upon performing calculation of said frequency shift, parameters
CORDICi and CORDICq are derived by using a calculation of said
coordinate rotation digital computation by replacing the signal
to be calculated the phase with I and Q components, and in
calculation of said coordinate rotation digital computation,
10 when a parameter for outputting a final angle by adding angles
per taps is set as phase, in former stage of said coordinate
rotation digital computation, a process expressed by:

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

15 $\text{CORDICi} = \text{CORDICq}$

$\text{CORDICq} = \text{CORDICi} * -1.0$

 phase = $\pi / 2$

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

20 $\text{CORDICi} = \text{CORDICq} * -1.0$

$\text{CORDICq} = \text{CORDICi}$

 phase = $-(\pi / 2)$

is performed.

15. A portable radio system as set forth in claim 13, wherein,
upon performing calculation of said frequency shift, parameters
CORDICi and CORDICq are derived by using a calculation of said
5 coordinate rotation digital computation by replacing the signal
to be calculated the phase with I and Q components, and in
calculation of said coordinate rotation digital computation,
when a parameter for outputting a final angle by adding angles
per taps is set as phase, in former stage of said coordinate
10 rotation digital computation, a process expressed by:

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

$\text{CORDICi} = \text{CORDICi} * -1$

$\text{CORDICq} = \text{CORDICq} * -1$

15 phase = π

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

$\text{CORDICi} = \text{CORDICi} * -1$

$\text{CORDICq} = \text{CORDICq} * -1$

20 phase = $-\pi$

is performed.

16. A portable radio system as set forth in claim 11, wherein

said control means sets said interval at a predetermined minimum value when out of synchronization is detected at least from failure of decoding or non-detection of pilot and not reaching of power to a predetermined level.

5

17. A portable radio equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of own portable radio equipment with reference to a received wave transmitted from a base station having higher 10 precision of frequency and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator,

wherein coordinate rotation digital computation (CORDIC) is employed for calculation of arctangent in said automatic 15 frequency control.

18. A portable radio equipment as set forth in claim 17, wherein, upon calculation of arctangent, calculation is performed within a range of $\pm \pi$.

20

19. A portable radio equipment as set forth in claim 17, wherein, upon performing calculation of said frequency shift, parameters CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal 25 to be calculated the phase with I and Q components, and in

calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

5

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

$\text{CORDICi} = \text{CORDICq}$

$\text{CORDICq} = \text{CORDICi} * -1.0$

$\text{phase} = \pi / 2$

10

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

$\text{CORDICi} = \text{CORDICq} * -1.0$

$\text{CORDICq} = \text{CORDICi}$

$\text{phase} = -(\pi / 2)$

15

is performed.

20. A portable radio equipment as set forth in claim 17, wherein, upon performing calculation of said frequency shift, parameters 20 CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal to be calculated the phase with I and Q components, and in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles

per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

5 $\text{CORDICi} = \text{CORDICi} * -1$

$\text{CORDICq} = \text{CORDICq} * -1$

 phase = π

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

10 $\text{CORDICi} = \text{CORDICi} * -1$

$\text{CORDICq} = \text{CORDICq} * -1$

 phase = $-\pi$

is performed.

15

~~1.~~ A portable radio equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of own portable radio equipment with reference to a received wave transmitted from a base station having higher 20 precision of frequency and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station

on the basis of a timing generated by said internal oscillator;
frequency shift calculating means for calculating a
frequency shift of said internal oscillator by dividing said
phase difference derived by said calculating means by an interval
5 of said two symbols; and
control means for controlling for widening said interval
when said phase difference derived by said calculating means
is smaller than a predetermined set value and for narrowing
said interval when said phase difference is greater than said
10 set value.

22. A portable radio equipment as set forth in claim 21, wherein
said two symbols are the same phase when a frequency of said
internal oscillator is correct, and
15 said calculating means derives a phase difference of said
two symbols by multiplying one of said two symbols by a complex
conjugate of another symbol.

23. A portable radio equipment as set forth in claim 22, wherein
20 upon calculation of arctangent by employing coordinate rotation
digital computation, said frequency shift calculating means
performs calculation within a range of $\pm \pi$.

24. A portable radio equipment as set forth in claim 23, wherein,
25 upon performing calculation of said frequency shift, parameters

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CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal to be calculated the phase with I and Q components, and in calculation of said coordinate rotation digital computation, 5 when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

10 $\text{CORDICi} = \text{CORDICq}$

$\text{CORDICq} = \text{CORDICi} * -1.0$

$\text{phase} = \pi / 2$

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

15 $\text{CORDICi} = \text{CORDICq} * -1.0$

$\text{CORDICq} = \text{CORDICi}$

$\text{phase} = -(\pi / 2)$

is performed.

20

25. A portable radio equipment as set forth in claim 23, wherein, upon performing calculation of said frequency shift, parameters CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal

to be calculated the phase with I and Q components, and in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate 5 rotation digital computation, a process expressed by:

when $\text{CORDIC}_i < 0.0$ and $\text{CORDIC}_q > 0.0$

$\text{CORDIC}_i = \text{CORDIC}_i * -1$

$\text{CORDIC}_q = \text{CORDIC}_q * -1$

10 $\text{phase} = \pi$

when $\text{CORDIC}_i < 0.0$ and $\text{CORDIC}_q < 0.0$,

$\text{CORDIC}_i = \text{CORDIC}_i * -1$

$\text{CORDIC}_q = \text{CORDIC}_q * -1$

15 $\text{phase} = -\pi$

is performed.

26. A portable radio equipment as set forth in claim 21, wherein
20 said control means sets said interval at a predetermined minimum
value when out of synchronization is detected at least from
failure of decoding of non-detection of pilot and not reaching
of power to a predetermined level.

27. A portable radio equipment employing an automatic frequency control for detecting a frequency shift of an internal oscillator of own portable radio equipment with reference to a received wave transmitted from a base station having higher precision of frequency and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising:

calculating means for calculating a phase difference of two symbols taken from a known data modulated by said base station
10 on the basis of a timing generated by said internal oscillator;

frequency shift calculating means for calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating means by an interval of said two symbols; and

15 control means for controlling for widening said interval when a value of said frequency shift derived by said frequency shift calculating means is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater than said predetermined value.

20

28. A portable radio equipment as set forth in claim 27, wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

25 said calculating means derives a phase difference of said two symbols by multiplying one of said two symbols by a complex

conjugate of another symbol.

29. A portable radio equipment as set forth in claim 27, wherein upon calculation of arctangent by employing coordinate rotation 5 digital computation, said frequency shift calculating means performs calculation within a range of $\pm \pi$

30. A portable radio equipment as set forth in claim 29, wherein, upon performing calculation of said frequency shift, parameters 10 CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal to be calculated the phase with I and Q components, and in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles 15 per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

$\text{CORDICi} = \text{CORDICq}$

20 $\text{CORDICq} = \text{CORDICi} * -1.0$

$\text{phase} = \pi / 2$

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

$\text{CORDICi} = \text{CORDICq} * -1.0$

CORDICq = CORDICi

phase = -($\pi/2$)

is performed.

5

31. A portable radio equipment as set forth in claim 29, wherein, upon performing calculation of said frequency shift, parameters CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal 10 to be calculated the phase with I and Q components, and in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

15

when CORDICi < 0.0 and CORDICq > 0.0

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = π

20

when CORDICi < 0.0 and CORDICq < 0.0,

CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = $-\pi$

is performed.

32. A portable radio equipment as set forth in claim 27, wherein
5 said control means sets said interval at a predetermined minimum
value when out of synchronization is detected at least from
failure of decoding or non-detection of pilot and not reaching
of power to a predetermined level.

10 ~~33.~~ A frequency error predicting method employing an automatic
frequency control for detecting a frequency shift of an internal
oscillator of portable radio equipment with reference to a
received wave transmitted from a base station having higher
precision of frequency and adjusting the frequency of said
15 internal oscillator by feeding back said frequency shift to
said internal oscillator,

wherein coordinate rotation digital computation (CORDIC)
is employed for calculation of arctangent in said automatic
frequency control.

20

34. A frequency error predicting method as set forth in claim
33, wherein, upon calculation of arctangent, calculation is
performed within a range of $\pm \pi$.

25 35. A frequency error predicting method as set forth in claim

34, wherein, upon performing calculation of said frequency shift, parameters CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal to be calculated the phase with I and Q components, 5 and in calculation of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

10

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$
 $\text{CORDICi} = \text{CORDICq}$
 $\text{CORDICq} = \text{CORDICi} * -1.0$
 $\text{phase} = \pi/2$

15

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,
 $\text{CORDICi} = \text{CORDICq} * -1.0$
 $\text{CORDICq} = \text{CORDICi}$
 $\text{phase} = -(\pi/2)$

20

is performed.

36. A frequency error predicting method as set forth in claim 34, wherein, upon performing calculation of said frequency shift,

parameters CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal to be calculated the phase with I and Q components, and in calculation of said coordinate rotation digital 5 computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

10 when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

$\text{CORDICi} = \text{CORDICi} * -1$

$\text{CORDICq} = \text{CORDICq} * -1$

$\text{phase} = \pi$

15 when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

$\text{CORDICi} = \text{CORDICi} * -1$

$\text{CORDICq} = \text{CORDICq} * -1$

$\text{phase} = -\pi$

20 is performed.

Sub 37 A portable radio system employing an automatic frequency control for detecting a frequency shift of an internal oscillator of portable radio equipment with reference to a received wave

transmitted from a base station having higher precision of frequency and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising of steps of:

5 calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

10 calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating step by an interval of said two symbols; and

15 controlling for widening said interval when said phase difference derived by said phase difference calculating step is smaller than a predetermined set value and for narrowing said interval when said phase difference is greater than said set value.

38. A portable radio system as set forth in claim 37, wherein said two symbols are the same phase when a frequency of said internal oscillator is correct, and

20 said phase difference calculating step derives a phase difference of said two symbols by multiplying one of said two symbols by a complex conjugate of another symbol.

39. A frequency error predicting method as set forth in claim 25 37, wherein upon calculation of arctangent of coordinate

rotation digital computation, said frequency shift calculating step performs calculation within a range of $\pm \pi$.

40. A frequency error predicting method as set forth in claim
5 39, wherein, upon performing calculation of said frequency shift, in said frequency shift calculating step, parameters CORDICi and CORDICq are derived by using a calculation of said coordinate rotation digital computation by replacing the signal to be calculated the phase with I and Q components, and in calculation
10 of said coordinate rotation digital computation, when a parameter for outputting a final angle by adding angles per taps is set as phase, in former stage of said coordinate rotation digital computation, a process expressed by:

15 when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

$\text{CORDICi} = \text{CORDICq}$

$\text{CORDICq} = \text{CORDICi} * -1.0$

$\text{phase} = \pi / 2$

20 when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

$\text{CORDICi} = \text{CORDICq} * -1.0$

$\text{CORDICq} = \text{CORDICi}$

$\text{phase} = -(\pi / 2)$

is performed.

41. A frequency error predicting method as set forth in claim
39, wherein, upon performing calculation of said frequency shift,
5 in said frequency shift calculating step, parameters CORDICi
and CORDICq are derived by using a calculation of said coordinate
rotation digital computation by replacing the signal to be
calculated the phase with I and Q components, and in calculation
of said coordinate rotation digital computation, when a
10 parameter for outputting a final angle by adding angles per
taps is set as phase, in former stage of said coordinate rotation
digital computation, a process expressed by:

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

15 $\text{CORDICi} = \text{CORDICi} * -1$

$\text{CORDICq} = \text{CORDICq} * -1$

$\text{phase} = \pi$

when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

20 $\text{CORDICi} = \text{CORDICi} * -1$

$\text{CORDICq} = \text{CORDICq} * -1$

$\text{phase} = -\pi$

is performed.

42. A frequency error predicting method as set forth in claim 37, wherein said interval controlling step sets said interval at a predetermined minimum value when out of synchronization 5 is detected at least from failure of decoding or non-detection of pilot and not reaching of power to a predetermined level.

~~43.~~ A frequency error predicting method employing an automatic frequency control for detecting a frequency shift of an internal 10 oscillator of portable radio equipment with reference to a received wave transmitted from a base station having higher precision of frequency and adjusting the frequency of said internal oscillator by feeding back said frequency shift to said internal oscillator, comprising the steps of:

15 calculating a phase difference of two symbols taken from a known data modulated by said base station on the basis of a timing generated by said internal oscillator;

calculating a frequency shift of said internal oscillator by dividing said phase difference derived by said calculating 20 step by an interval of said two symbols; and

controlling for widening said interval when a value of said frequency shift derived by said frequency shift calculating step is smaller than a predetermined value and for narrowing said interval when said value of said frequency shift is greater 25 than said predetermined value.

44. A frequency error predicting method as set forth in claim
43, wherein said two symbols are the same phase when a frequency
of said internal oscillator is correct, and

5 said phase difference calculating step derives a phase
difference of said two symbols by multiplying one of said two
symbols by a complex conjugate of another symbol.

45. A frequency error predicting method as set forth in claim
10 43, wherein upon calculation of arctangent of coordinate
rotation digital computation, said frequency shift calculating
step performs calculation within a range of $\pm \pi$

46. A frequency error predicting method as set forth in claim
15 45, wherein, upon performing calculation of said frequency shift,
in said frequency shift calculating step, parameters CORDICi
and CORDICq are derived by using a calculation of said coordinate
rotation digital computation by replacing the signal to be
calculated the phase with I and Q components, and in calculation
20 of said coordinate rotation digital computation, when a
parameter for outputting a final angle by adding angles per
taps is set as phase, in former stage of said coordinate rotation
digital computation, a process expressed by:

25 when $\text{CORDICi} < 0.0$ and $\text{CORDICq} > 0.0$

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CORDICi = CORDICq

CORDICq = CORDICi * -1.0

phase =  $\pi/2$ 
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5 when $\text{CORDICi} < 0.0$ and $\text{CORDICq} < 0.0$,

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CORDICi = CORDICq * -1.0

CORDICq = CORDICi

phase =  $-(\pi/2)$ 
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10 is performed.

47. A frequency error predicting method as set forth in claim
45, wherein, upon performing calculation of said frequency shift,
in said frequency shift calculating step, parameters CORDICi
15 and CORDICq are derived by using a calculation of said coordinate
rotation digital computation by replacing the signal to be
calculated the phase with I and Q components, and in calculation
of said coordinate rotation digital computation, when a
parameter for outputting a final angle by adding angles per
20 taps is set as phase, in former stage of said coordinate rotation
digital computation, a process expressed by:

```
when  $\text{CORDICi} < 0.0$  and  $\text{CORDICq} > 0.0$ 

CORDICi = CORDICi * -1
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CORDICq = CORDICq * -1

phase = π

when CORDICi < 0.0 and CORDICq < 0.0,

5 CORDICi = CORDICi * -1

CORDICq = CORDICq * -1

phase = $-\pi$

is performed.

10

48. A frequency error predicting method as set forth in claim
43, wherein said interval controlling step sets said interval
at a predetermined minimum value when out of synchronization
is detected at least from failure of decoding or non-detection
15 of pilot and not reaching of power to a predetermined level.